1. Introduction

1.1 Background

The Defense Information Infrastructure (DII) is an enterprise-level effort within the Department of Defense (DoD) to develop and field military systems that meet the needs of the warfighter in a global information environment. As indicated in the C4I for the Warrior concept, "the warrior needs a fused, real-time true-picture of the battlespace and the ability to order, respond, and coordinate vertically and horizontally to the degree necessary to prosecute the mission in that battlespace." DoD relies on the DII Common Operating Environment (COE) to provide the degree of system integration and interoperability required to achieve this vision.

The DII COE addresses systems in the command, control, communications, computers, and intelligence (C4I) and combat support domains within DoD. The C4I domain includes systems that facilitate the command and control of forces by the tactical commander, while the combat support domain includes systems that support logistics, transportation, base support, personnel, and health affairs functions. The Global Command and Control System (GCCS) and the Global Combat Support System (GCSS) are examples of C4I and combat support systems, respectively, that are based on the DII COE.

The DII COE provides a client-server architecture for developing reusable, interoperable software from which systems tailored to the specific needs of a user community can be built. A COE-based system is composed of software components, called segments, selected from the DII repository. Some segments are part of the COE because they perform common functions required by most systems, while other segments perform mission-specific functions that are targeted to particular operational communities. Software is included in the DII repository only if it conforms to strict standards and specifications that are required to support "plug and play" integration across a range of hardware platforms.

It is critical to the overall usability of a system that the software in the DII repository provide a user interface with a common appearance and behavior so that users can interact effectively with any system built from this software. User interface standardization is particularly important as users are provided the capability to interact with a variety of complex, multi-windowed applications within a single system. The benefits to be gained from standardization are increased user productivity, reduced training requirements, improved system reliability, and increased efficiency in the development of individual applications as well as entire systems.

1.2 Purpose

This document defines the user interface style to be delivered by software developed for the DII. The specifications provided here emphasize commonality in "look and feel" because it is a key element of usability as well as a requirement of the runtime environment defined by the DII. Compliance with DII specifications is mandated for all software in the DII repository because the specifications define the "rules" for a well-behaved application to operate predictably in a standard

runtime environment. Compliance is especially important since the applications in a system can be built from multiple segments, each produced by a different organization.

A common "look and feel" is one that provides consistency in the appearance and behavior of user interface objects while allowing flexibility for addressing operational requirements. Implementing a common "look and feel" enables users to identify, remember, and predict the rules and organization of a system. By building consistency in the user interface, users can develop an effective and efficient model of how the system works and can generalize this knowledge to other systems. According to Mayhew in Principles and Guidelines in Software User Interface Design, a consistent user interface is one that provides:

- Consistent location of certain types of information on screens,
- Consistent syntax of commands in a command language,
- Similar execution of analogous operations in different applications,
- Consistent design of command names and abbreviations,
- Consistent grammatical form of error messages and instructions,
- Consistent design of captions and fields on forms and displays,
- Consistent dialog style for different functions, and
- Terminology consistent with the users' existing vocabulary.

1.3 Scope

DoD policy concerning user interface standardization is published in the DoD Human Computer Interface Style Guide (i.e., volume 8 of the DoD Technical Architecture Framework for Information Management). This document allows DoD organizations to publish style addenda when more detailed specifications at a domain or system level are needed. The DII specifications comply with guidelines in the DoD style guide and serve as the addendum for the C4I and combat support domains. The specifications are consistent with Section 5.15 on user-computer interface in Military Standard (MIL-STD) 1472E and with Military Handbook (MIL-HDBK) 761A and reference other military standards and specifications providing direction with relevance to user interface design in DII systems.

This document provides style specifications for applications with a graphical user interface (GUI) or a browser-based interface. The specifications for GUI-based applications conform to the style defined in the Common Desktop Environment (CDE) version 1.0 of Motif[1] and in MS Windows for the NT workstation, and incorporate guidance published in the commercial literature on user interface design. An integrated set of specifications is provided whenever possible, with separate direction indicated where the two GUI style standards differ. The specifications deviate from Motif and MS Windows standards only when needed to accommodate operational requirements or constraints, provided that the deviations are consistent with established user interface guidelines. The specifications for browser-based applications are based on features available in

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[1] This version of Motif is based on OSF/Motif version 1.2 with CDE-specific additions. The DII specifications are consistent with certification requirements set forth in style documentation for CDE version 1.0 of Motif published by Triteal. The DII specifications will be updated to reflect more recent releases of Motif and CDE when they are included in the DII COE.

version 3.2 of the Hypertext Markup Language (HTML) and incorporate guidance on Web design published in the commercial literature and available on the Internet. DII specifications focus on the usability of Web applications and emphasize design consistency in the interest of providing the warfighter with rapid, effective access to information.[2]

DII specifications define user interface style where the primary mode of interaction is through a GUI or a Web browser. The specifications do not address the design of software providing a character-based interface or offer direction regarding possible migration of this software to a GUI-based interface. The specifications focus on the style attributes that compliant software must possess in order to be accepted into the DII repository and do not define or mandate a methodology for user interface development. This document provides user interface specifications related to input devices, user interaction models, application and window design, and information presentation; this document does not provide environmental or ergonomic specifications in areas such as lighting and noise or workstation design and layout.

1.4 Style Requirements

1.4.1 Assumptions Concerning the DII Environment

It is assumed that a DII system will contain a mix of native applications that users access locally and Web applications that users access via the Internet or local intranet. User interface services will be provided by X Window, Motif, and CDE on UNIX-based platforms and by MS Windows on NT-based platforms.[3] The system is expected to use the version of CDE/Motif or MS Windows available in the COE and provide Web services using the browser in the COE. The system will define the functionality (i.e., specific applications) available to different categories of users (e.g., operational personnel, system administrators) and will control access to these applications during system login. The workstatation configuration will include at least one color monitor, a keyboard, and a pointing device (such as a mouse or trackball) with two or three buttons. While it is expected that DII systems will be installed in a range of operational settings, the specifications provided here assume an office-like workspace with normal ambient lighting to be the default environment.

1.4.2 DII Requirements for Style Implementation

A DII application is expected to deliver a user interface that supports user performance and decision making. The application can use a GUI such as Motif or MS Windows to present a windowing environment and interface components with which users can interact, or it can rely on the style features of a browser to provide access to Web-based information. If the application supports Web-based interactive capabilities, users can encounter GUI components in a browser-based environment. Because visual and functional consistency within and among applications is a

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[2] This focus on "style" as it relates to the usability differs from that in most HTML style guides which discuss how to construct markup tags so they are readable and usable across browsers.

[3] Network-centric user interfaces are being designed for use on PCs and network computers. These interfaces combine elements of a traditional GUI-based desktop with features provided in a browser. There are as yet no standards or specifications available that define the style for this type of interface.

key element of usability, DII defines the following style requirements for GUI- and browser-based interfaces in all compliant software:

· A native application with a Motif user interface shall have a DII-compliant Motif style.
· A native application with an MS Windows user interface shall have a DII-compliant MS Windows style.
· A Web application with a browser interface shall have a DII-compliant browser style.
· A Web application with GUI functionality shall have a DII-compliant style that matches the GUI of the host platform.

A DII application is expected to possess all of the style attributes of a Motif- or MS Windows-based user interface. These attributes include both the appearance and behavior (i.e., "look and feel") of individual interface components as well as the design rules for the labeling, ordering, and placement of these components. The application implements style attributes in accordance with Motif and MS Windows standards and does not provide interface components that are unique to a particular platform.

Motif and MS Windows provide a similar "look and feel" in the set of components each supports but differ in some design rules that contribute unique style features to each GUI. DII specifications define the style attributes of Motif and MS Windows interface components that may be present in an application. It is expected that the application will implement the set of components required for effective performance of mission-related tasks and then ensure that these components have a DII-compliant style whenever they are present in the application.

A Web application relies on a browser to render Web-based information whose appearance and content have been formatted in accordance with HTML standards. The user interface for these applications makes use of the style tags supported by HTML and is designed for effective information presentation and navigation as defined by the specifications provided here. A Web application is expected to deliver a compliant style when viewed on different browsers and platforms and to ensure that application functionality is not compromised as a result of browser- or platform-specific features.

The capabilities of a Web application can be extended to allow user interface components to be embedded in a browser window or available as a standalone application outside the browser. Platform-independent languages such as Java can be used to add interactive capabilities and multimedia extensions to a Web application so that the user interface can resemble that of other applications that users access locally.[4] DII requires that a Web application with GUI functionality deliver the same style as a native application on the host platform. The application is expected to provide the appropriate "look and feel" of individual interface components as well as comply with the visual design rules for each GUI. If the application cannot adapt its style to fit these rules

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[4] At present, there are no standards or specifications that define the user interface style to be provided by a Java application. The specifications provided here assume that these applications will provide the same "look and feel" as a native application on the host platform.

(e.g., adjust the order and placement of components) for each GUI, it complies with the MS Windows design rules as defined in DII specifications.[5]

DII specifications require consistency in style implementation of commonly used interface components regardless of the development environment selected to render the components. For example, when an application displays a push button in Motif, it is expected to have the style attributes called for by DII specifications, whether it was generated using the Motif toolkit, a GUI builder or virtual prototyping product, or a set of platform-independent windowing class libraries. DoD organizations are responsible for selecting a development tool that results in a user interface with the style attributes defined here. Software that makes use of commercial off-the-shelf (COTS) tools or integrates COTS products shall be configured to comply with DII specifications insofar as possible. DoD organizations need to determine the extent to which a tool or product will generate a user interface with a noncompliant style and if these divergences will have a negative impact on usability when the software is integrated with other DII-compliant applications.

1.5 Compliance

1.5.1 Segment-Level Compliance

Compliance with DII style specifications is required in the development of all new software and the migration of existing software submitted for inclusion in the DII repository. DoD organizations are expected to comply with all style specifications, with deviations occurring only when called for by operational requirements and approved by the Defense Information Systems Agency (DISA). New software shall be developed in accordance with DII requirements and be fully compliant with all style specifications; existing software is expected to migrate to full DII compliance. DoD organizations shall comply with the intent of the specifications; this document defines the style requirements for compliant software and does not attempt to preclude all possible inappropriate, incorrect, or unacceptable implementations.

Appendix I maps DII style specifications to each of the style-related items included in the COE compliance checklist published in DII COE Integration and Runtime Specification (I&RTS). A segment must satisfy all of the requirements for a given style-related item in order to be considered to comply with the item. As indicated in the I&RTS, the compliance level assigned to a segment is the highest numbered level where all of the checklist items have been satisfied. To be considered DII-compliant in the style area, a segment must demonstrate that it has satisfied all of the style-related requirements up to and including that level. Previous versions of DII style specifications included a checklist for DoD organizations to determine if a segment complies with all relevant style requirements. This checklist has been updated to reflect the specifications included here and converted into database form so that it can be administered as an automated assessment protocol. The checklist database and a prototype version of this protocol will be available in the DII COE Developers Toolkit.

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[5] Compliance with MS Windows design rules is required since users are expected to interact with these applications on a PC client where the native style is MS Windows.

DISA will specify the style requirements to be satisfied at each COE compliance level and provide direction concerning submission of style compliance documentation by DoD organizations intending to deliver software to the DII repository. If a deviation from style compliance requirements is desired, organizations shall request a waiver from DISA; if approved, waivered items can be excluded when software is assessed for compliance. DISA shall verify the style compliance of the software and determine whether to certify it at the level requested.

1.5.2 System-Level Compliance

The extent to which a system is DII-compliant is determined by aggregating the compliance levels of its component segments. The I&RTS explains how to compute the compliance level of a COE-based system. Because style-related items are included in the COE compliance checklist, the overall style compliance of a system is reflected in its level of compliance in the runtime environment category. Organizations desiring to deliver a DII-compliant system but with operational requirements that dictate an alternate style implementation shall obtain a waiver from DISA in order to diverge from DII specifications.

DoD organizations desiring to define system-specific user interface requirements not addressed here or previously waivered by DISA shall do so by documenting them in an addendum to this document. The addendum shall provide detailed guidance concerning user interface features not specifically addressed here as they relate to the needs of the user community for whom the system is intended. The addendum shall maintain consistency with the user interface style defined by DII, extending the scope and content of the specifications as needed to address unique user requirements. The addendum shall be written so that it supplements, rather than duplicates, information already included here. Republication of the DII specifications, with changes to reflect system-unique requirements, is strongly discouraged.

1.5.3 Minimum Style Requirements for DII Compliance

While DII style specifications allow DoD organizations to tailor the user interface to fit mission requirements, there are some elements of a user interface that shall not be modified in DII software. The following elements are central to the fundamental paradigm underlying a graphical interface and are considered essential to the DII integration process at the user interface level:

- The hotspot of the pointer indicates the locus of user input with the pointing device.
- The location cursor indicates the locus of user input from the keyboard.
- Only one window has input focus at any time and can accept keyboard input.
- Window management operations affect only the windows in a window family.

DII software must satisfy these minimum requirements in order to achieve level 1 style compliance. Requests for waivers to diverge from these requirements shall be directed to DISA and considered on a case-by-case basis.

1.5.4 Modifications to Style Specifications

DII style specifications shall be modified as needed to ensure continued compliance with Motif and MS Windows style direction, maintain consistency with DoD policy and publications on user interface design, and address new technologies, especially as they relate to the evolution of Web-based desktops and network-centric user interfaces. The specifications will be revised as needed to maintain currency with the COE and document the evolution of the DII user environment. Requests to modify the specifications shall be submitted for consideration in accordance with configuration management procedures established for the document by DISA. Requests to modify the implementation of a user interface feature in DII software shall be directed to the organization with configuration management responsibility for the software.

1.6 Document Overview

The remainder of this document describes the interface components and design rules for Motif and MS Windows applications and provides direction on page design and information presentation in Web applications. The appendices offer detailed information related to keyboard input, action vocabulary and graphics, developer notes, and style compliance. Unless otherwise indicated, the specifications apply to both Motif and MS Windows interfaces; if a specification applies to only one of the GUIs, it is identified as such.

·   Sections 2 and 3 describe the input devices available to users and the manner in which they use these devices to interact with an application.

·   Sections 4, 5, and 6 address the appearance and behavior of windows, menus, and controls in the application.

·   Section 7 describes application design and the integration of applications in a system. Section 8 contains visual design guidelines for primary and secondary windows, with section 9 providing specific formats for secondary windows.

·   Sections 10 and 11 focus on the design of tactical displays and user support resources, while section 12 addresses the presentation of text and graphic information.

·   Sections 13 and 14 describe page design, the presentation of text, images, and multimedia, and interactive capabilities in Web applications.

·   Section 15 provides guidance related to user interface internationalization.[6]

·   Appendix A identifies the functions assigned to keys in Motif and MS Windows, and appendix B maps these keys to the keyboards for several DII hardware platforms.

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[6] This section is included for use by DoD organizations with a requirement to provide internationalized software and is not considered in determining DII style compliance.

- Appendix C defines standard vocabulary, mnemonics, and shortcut keys for common actions; appendix D provides graphics for some of these actions.

- Appendix E contains developer notes describing color sets, fonts, and application icon design in Motif and MS Windows.

- Appendix F lists acronyms and abbreviations used in the document. Appendix G maps the terminology in this document to that in Motif and MS Windows documentation, while Appendix H provides a glossary of style terminology.

- Appendix I maps the style specifications to DII compliance levels.

1.7 Typographic Conventions

The following typographic conventions are used in this document:

- Push button actions (e.g., Cancel, OK) and menu titles and options (e.g., File, Open) are capitalized.

- The left, middle, and right buttons on the pointing device are referred to as BLeft, BMiddle, and BRight, respectively.

- The names of keys on the keyboard are presented in capital letters (e.g., RETURN).[7] Simultaneous key combinations are indicated by presenting the key names separated by a plus; for example, CTRL+HOME means that users hold down the CTRL key and then press the HOME key.

- HTML tags are indicated by brackets (e.g., <title>).

- References to the Microsoft Windows™ user interface and style are identified as "MS Windows" in order to differentiate them from statements about generic windows.

1.8 Source Documents

The DII specifications are based on the guidelines, standards, and style guides listed below.

Government Documents

Avery, L.W. & O'Mara, P.A. DoD World Wide Web Site Human-Computer Interface Style Guide, Draft Version 1.0, 1996.

Avery, L.W. & Bowser, S.E. (eds.) Human Factors Design Guidelines for the Army Tactical Command and Control System (ATCCS) Soldier-Machine Interface, Version 2.0.

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[7] The use of capital letters is a typographic convention and does not indicate how the names of keys are to be displayed by the application.

Pacific Northwest Laboratory for the U.S. Army Tactical Command and Control System Experimentation Site, Fort Lewis, WA, 1992.

Bowen, C.D. Theater Battle Management (TBM) Human Computer Interface (HCI) Specification, Version 1.2. The MITRE Corporation, Bedford, MA, 1995.

Defense Information Systems Agency. Defense Information Infrastructure (DII) Common Operating Environment (COE) Integration and Runtime Environment Specification (I&RTS), Version 3.0, 1997.

Defense Information Systems Agency. Defense Information Infrastructure Master Plan, Version 3.0, 1995.

Defense Information Systems Agency. Department of Defense Human Computer Interface Style Guide. Department of Defense Technical Architecture Framework for Information Management, Version 3.0, Volume 8, 1996.

Department of Defense. Military Handbook 761A. Human Engineering Guidelines for Management Information System. Department of Defense, Washington, D.C., September 1989.

Department of Defense. Military Standard 1472E. Department of Defense Design Criteria Standard: Human Engineering. U.S. Army Aviation and Missile Command, Huntsville, AL, 1996.

Department of the Air Force, Standard Systems Center (SSC). Graphical User Interface (GUI) Standards, Volume 1, 1993.

Operations Directorate Graphical User Interface Standards. Version 1.0. Prepared by the Joint DO/DT GUI Standards Working Group, 1994.

Smith, S.L. & Mosier, J.N. Guidelines for Designing User Interface Software (ESD0TR086-278). USAF Electronic Systems Center, Hanscom AFB, MA, 1986.

Non-Government Documents

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Apple Computer, Inc. Human Interface Guidelines: The Apple Desktop Interface. Reading, MA: Addison-Wesley Publishing Co., 1987.

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Fowler, S.L. & Stanwick, V.R. The GUI Style Guide. Boston, MA: Academic Press, Inc., 1995.

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Mansfield, R. & Brannon, C. Microsoft Windows NT4 Workstation Desktop Companion. Research Triangle Park, NC: Ventana Communications Group, Inc., 1997.

Marcus, A., Smilonich, N. & Thompson, L. The Cross-GUI Handbook for Multiplatform User Interface Design. Reading, MA: Addison-Wesley Publishing Co., 1995.

Mayhew, D.J. Principles and Guidelines in Software User Interface Design. Englewood Cliffs, NJ: PTR Prentice Hall, 1992.

Microsoft Corporation. The Windows Interface Guidelines for Software Design. Redmond, WA: Microsoft Press, 1995.

O'Donnell, S.M. Programming for the World: A Guide to Internationalization. Englewood Cliffs, NJ: Prentice Hall, 1994.

Open Software Foundation. OSF/Motif Style Guide. Release 1.2. Englewood Cliffs, NJ: Prentice Hall, 1992.

Open Software Foundation. <u>OSF/Motif User's Guide. Release 1.2</u>. Englewood Cliffs, NJ: Prentice Hall, 1992.

Perry, P.J. <u>Creating Cool Web Applets with Java</u>. Foster City, CA: IDG Books Worldwide, Inc., 1996.

Root, R.W. & McFarland, A.D. Graphical User Interface Design Guidelines for Bellcore Software Products. Issue 1. Bellcore/Bell Communications Research, Piscataway, NJ, 1993.

Shafran, A. <u>Enhancing Netscape Web Pages</u>. Indianapolis, IN: Que Corporation, 1996.

TriTeal Corporation. <u>TriTeal Enterprise Desktop (TED) 4.0 Advanced User's and System Administrator's Guide</u>. Carlsbad, CA: TriTeal Corporation, 1995.

TriTeal Corporation. <u>TriTeal Enterprise Desktop (TED) 4.0 Style Guide and Certification Checklist</u>. Carlsbad, CA: TriTeal Corporation, 1995.

Uren, E., Howard, R. & Perinotti,T. <u>Software Internationalization and Localization: An Introduction</u>. New York: Van Nostrand Reinhold, 1993.

User Interface Design With OSF/Motif. Open Software Foundation Training Course, Version 1.2, 1992.

<u>Web Documents</u>

Apple Web Design Guide. Apple Computer, Inc., 1997.
http://www.applenet.apple.com/hi/web/intro.html

Australian Department of Primary Industries & Energy. PIENet Web Publishing Standards & Guidelines, 1997. http://www.dpie.gov.au/dpie/web/standards.html

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The National Center for Supercomputing Applications. A Beginner's Guide to HTML.
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Tilton, J.E. Composing Good HTML. Carnegie-Mellon University, 1997.
http://www.cs.cmu.edu/~tilt/cgh/

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Accessibility Guidelines. University of Wisconsin, Madison, 1997.
http://trace.wisc.edu/TEXT/guidelns/htmlgide/htmlgide.html

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Department of the Army. Army Field Manual FM 101-5-1. Operational Terms and Symbols. U.S. Army Combined Arms Center, Fort Leavenworth, KS, 1997.

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Department of Defense. Military Standard 2525A. Common Warfighting Symbology, 1996.

North Atlantic Treaty Organization Standardization Agreement 2019. Military Symbols for Land-Based Systems, 1990.

Standards relating to the design of workstations, associated furniture, and the facilities in which they are placed can be found in MIL-STD 1472E and the following document:

American National Standards Institute. National Standard for Human Factors Engineering of Visual Display Terminal Workstations. Santa Monica, CA: The Human Factors Society, Inc., 1988.

DoD guidance on these topics can be found in the following document:

Department of Defense. DoD Human Computer Interaction (HCI) Concept Plan (Revised), 1995.